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THIS PUBLICATION GIVES INFORMATION on new developments of interest to agriculture based on the work done by scientists and agricultural field men of the du Pont Company and its subsidiary companies.

It also gives reports of results obtained with products developed by these companies in the field whether the tests are made by field men of the companies, by agricultural experiment stations or other bodies. Also data on certain work done by agricultural stations on their own account and other matters of interest in the agricultural field.

This issue contains:

The Contributions Science is Making to the Development of More Effective Pest Control.

Organic Mercury Compounds Found Effective for Control of Bacterial Blight of Cotton.

An Improved Formaldehyde Treatment for Damping-off Control Successful.

Chemical Sanitation in the Flour Mill; A Discussion of Materials and Methods.

Fertilizer Investigations Conducted in Alabama Point Way to Increase Value of the Cotton Crop.

Methods of Blasting Lateral-Rooted Stumps in Terracing Work to Prevent Soil Erosion.

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YOU ARE INVITED TO SUBMIT CONTRIBUTIONS FOR USE IN THE AGRICULTURAL NEWS LETTER

In line with the policy of the AGRICULTURAL NEWS LETTER to present the results of researches and experiments which properly should be printed in this publication, the editor will be glad to receive contributions from agricultural experiment stations and other agencies and individuals.

As is known to readers, it has been our privilege to publish papers and articles by technical workers in the United States Department of Agriculture, those engaged in research at experiment stations, and scientists connected with industrial organizations. Mostly, these contributions have been written expressly for the AGRICULTURAL NEWS LETTER.

It is believed that, through this medium, deserved publicity can be given to work not already reported in scientific journals or the publications of various societies. Such reporting of the results of research and experiments could be of real value to our readers and the authors, also.

It will be appreciated if those who may care to prepare papers will advise us, in order that the matter may be discussed by correspondence.

S. W. LONG, EDITOR,
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WILMINGTON, DELAWARE.

THE CONTRIBUTIONS SCIENCE IS MAKING TO THE DEVELOPMENT OF MORE EFFECTIVE PEST CONTROL

EDITOR'S NOTE:- In this article Dr. Tisdale summarizes significant achievements resulting from research and forecasts the future trend along lines wherein biologists and chemists will cooperate in the development of a more thorough understanding of the bio-chemical functions of parasitism in plants and animals.

By W. H. Tisdale, In Charge, Pest Control Section,
The Grasselli Chemical Company, Cleveland, Ohio.

Insects are considered by some of our leading entomologists to be man's most formidable enemy. The enormous damage caused by the thousands of species of destructive insects in addition to that caused by numerous other pests, such as rodents and other destructive animals, arachnida, worms, bacteria, protozoa, fungi and weeds may be recorded in terms of billions of dollars annually. Pests are universally present, inhabiting soils, water and air. Plants and animals, and the many valuable products of plant and animal origin on which we subsist, are subject to heavy attacks by numerous pests. In addition to suffering heavy losses of his means of subsistence man himself suffers and often succumbs to the ravages of parasites or pests of one kind or another. Scientific studies indicate that some of these pests, particularly insects, antedate the human race. Evidently man has struggled with pests from his beginning.

The human population has continued to multiply and spread, in spite of these enemies, until virgin lands are almost depleted. Agriculture and industry have become more intensified and specialized. Transportation systems are highly developed. Such conditions have favored the more rapid spread and multiplication of some of our most destructive pests. This progress and spread of man has been due in a large measure to his scientific achievements. During the past century a great deal has been accomplished toward the eradication or control of pests causing serious epidemic diseases of humans and the plants and animals on which they subsist. The biological and chemical sciences have played a very important part in this progress. The development of disease resistance in plants and animals, the development of immunity through the application of vacines, serums and antitoxins, and the use of scientific chemical formulae are rapidly replacing the crude or unscientific measures and faith cures of the past. Aside from the direct chemical means employed in pest control, chemistry serves a leading role in an understanding of resistance and immunity.

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Organized Programs of Research

In the development of pest control measures in the past the responsibility until comparatively recently has been left with layman and with scientists of biological training. In the search for chemicals for such use compounds of known poisonous nature naturally were selected. Use is made of many inorganic compounds and certain organics including the extracts of poisonous plants. More recently some very effective organo-metallic and purely organic compounds have been discovered for specific uses. These developments are the result of organized programs of research in which the biologists and chemists are cooperating closely for the purpose of developing chemicals for specific pest control purposes. The time when biologists responsible for the developing of chemical control measures for agricultural pests think chiefly in terms of by-products from the chemical industries is rapidly passing. The problem of developing satisfactory chemicals for pest control is just as important and in many ways more delicate, due to the host-parasite relationship, than many other problems with which the chemist has to deal.

The Need for New Materials

Many of the chemicals now in common use for the control of pests are highly poisonous to animals and man. Some are cumulative poisons. Some are corrosive and others present fire hazards. Federal and State regulatory measures have to a certain extent protected the health of the people against the dangers involved. More recently the Federal Government has taken definite steps to protect the consumer by issuing more exacting regulations regarding the appearance of arsenic, lead and fluorine compounds on fruit and vegetables which are handled in interstate shipments. Such regulations will probably be extended and made more exacting in the future, especially in the case of violent and cumulative poisons.

There is an urgent need for less poisonous or non-poisonous compounds to replace the more dangerous chemicals now in use in many fields of pest control. In addition to the injury that may be caused to valuable animals and human beings by pest control chemicals, many of the products used on plants often cause more injury than would have been caused by the parasite if no control measure were used. Chemicals used for destroying farm weeds may, in addition to other hazards, leave a residue in the soil that is detrimental to crop plants. The need is for products with greater effectiveness that can be used with safety to plants, animals and man. Many of the chemicals used for the control of human diseases are not safe. There are many control problems as yet unsolved for which satisfactory chemicals are needed.

Trend is Toward Specifics

In view of our present knowledge of the differences in reaction or sensitivity of species, varieties and even individuals in the plant

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and animal kingdoms it appears quite likely that future progress in the development of safe and effective pest control chemicals will be along the lines of specifics, developed through a thorough understanding of the bio-chemical functions and chemical composition of host and parasite. There appears to be much greater possibility for the discovery of specifics of this kind in the field of organic chemistry. Many of our cumulative poisons are metallic or inorganic chemicals. The inorganics have been rather thoroughly explored while the possibilities for developing synthetic organic compounds appear to be almost unlimited. A number of very promising organics already have been developed for use as bactericides, fungicides and insecticides.

Until satisfactory products are found to replace the poisonous chemicals now in use it will be necessary to continue to use them. During their continued use it is important that every effort be made to reduce the poison hazards to a minimum. This may be done through more careful handling, through improved physical and chemical compositions and more thorough applications properly timed to produce a higher degree of efficiency per unit of toxin. Improved methods of removing poison from fruit, vegetables and other food products is important.

Importance of Improvements in Properties

Improvements in physical and chemical properties and in compounding are important not only for the highly poisonous materials but for pest control products generally.

Purity, particle size, electric charge, solubility and inert carriers are important in many instances. Inert carriers should be chemically inert or at least compatible with the active ingredients. The active chemical should be stable or sufficiently stable to function satisfactorily without releasing detrimental by-products. There are indications that the question of stability will be a more disturbing factor in the field of organics than it is with inorganics. Volatility is important depending on the nature and usage of the product. Assistants for agricultural sprays such as wetting, spreading and sticking agents should continue to receive consideration. A great deal of progress already has been made toward the development of compounds of this type that are convenient to use and can be used successfully in hard waters and in acid and alkaline solutions. Some of these compounds in addition to assuring more thorough application when properly used seem to activate the toxic agents. Emulsification, floculation or defloculation and materials that produce satisfactory adhesion are problems deserving further consideration.

Assistants for Pest Control Chemicals

Too much attention cannot be given to the use, in proper quantities, of assistants for pest control chemicals. This applies to all products not used in pure form. For this reason the development of

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supplimentary chemicals and the compounding of these with the chief active ingredients for specific purposes takes on a degree of importance which is probably equal to the discovery of the toxic compounds.

The future trend of chemical pest control appears to be toward a much closer cooperation of biologists and chemists in the development of a more thorough understanding of the bio-chemical functions of parasitism in plants and animals, which in addition to the present advanced state of knowledge in these sciences will aid them in the development of compounds highly effective for specific uses and not injurious to the host plant or animal and safe for man to use. Nature has presented examples of products of this type in the so-called fish poison plants and others. A better understanding of how these organics are formed may prove valuable in synthesizing products that are even more effective and products the production of which can be controlled for uniformity. The progress already made in this direction is very encouraging.

ORGANIC MERCURY COMPOUNDS FOUND EFFECTIVE FOR CONTROL OF BACTERIAL BLIGHT OF COTTON

EDITOR'S NOTE:- The excerpts below are from "Cotton Diseases and Methods of Control", Farmers' Bulletin No. 1745, U. S. Department of Agriculture, issued May, 1935.

By David C. Neal, Senior Pathologist, Division of Cotton and Other Fiber Crops and Diseases, and W. W. Gilbert, Senior Pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry.

Cotton is the most important crop in the Southern States, and within recent years a considerable expansion of the industry has occurred in the irrigated and semiarid sections of the Southwest. In most of the cotton-growing area of the United States the crop is frequently attacked by plant diseases, some of which cause serious losses.

Estimates of the Plant Disease Survey of the Bureau of Plant Industry indicate a loss to the cotton crop from plant diseases in 1932 of 1,687,000 bales. Several of the cotton-producing States were not considered in these estimates, however, and from observations the writers believe that the loss from this cause actually exceeds 2,000,000 bales annually.

The most effective method of controlling blight is to use disease-free seed. The seed may be practically freed of the blight bacteria if treated with special dust disinfectants or if delinted with sulphuric acid or with hydrochloric acid gas.

The most effective dust disinfectants are some of the organic mercury compounds. Seed treated with these dusts at the rate of four ounces per bushel has given excellent stands of cotton with a minimum of blight-infected seedlings.

The seed to be treated is placed in a large closed drum, large cans, or wooden containers with the requisite amount of dust disinfectant and shaken vigorously for 15 to 20 minutes to insure a thorough coating of the dust on the seeds. The seed may then be planted immediately or kept in the containers for any length of time with no danger of injury from the treatment.

Control by Delinting Methods

Experiments have shown that delinting cottonseed with sulphuric acid is quite effective in eliminating blight bacteria from seed. Seed

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so treated, however, may give only fair to poor germination, when cold or wet weather follows planting. Especially is this true where the crop is grown under irrigation. The method is also tedious, cumbersome, and dangerous for the grower to use and is not advised as a general farm practice, although it is used by breeders for special lots of seed stocks.

Another method of delinting cottonseed for the control of blight and other diseases, developed in the Bureau of Plant Industry, is the hydrochloric acid gas process*. This method requires special equipment for treating the seed. It has the advantage over the sulphuric-acid method in that the seed is kept dry throughout the treatment. The method is feasible, however, only on a commercial basis.

All Seed Used on Farm Should Be Treated

To be effective, treatment for blight control should include all seed used on the farm. Better still is a community program of seed treatment. If one grower practices seed treatment and the grower on an adjoining plantation does not, the blight bacteria may later be disseminated to the disease-free plants in fields where the seed was treated, produce infection, and reduce the benefits of treatment. A great benefit from seed treatment, however, comes in warding off infection in the seedling stages and insuring more uniform stands and more rapid growth as the season advances.

*U. S. patent No. 1425688.

Editor's Notes:

2% "Ceresan", an organic mercury compound, has been used successfully for the control of bacterial blight of cotton.

"Ceresan" is the trade name registered by the Bayer-Semesan Company, Wilmington, Delaware, to cover this product.

AN IMPROVED FORMALDEHYDE TREATMENT FOR DAMPING-OFF CONTROL SUCCESSFUL

EDITOR'S NOTE:- The results of investigations reported here are certain to attract further attention to the usefulness of formaldehyde for soil disinfestation. This article by Drs. Guterman and Massey is reprinted from the Florists Exchange, New York, N. Y., in which it first appeared. Acknowledgement of permission to use it is made to the publishers.

By C. E. F. Guterman and L. M. Massey,
Department of Plant Pathology,
Cornell University, Ithaca, N. Y.

Probably all who raise plants from seed are familiar with the complex of diseases to which the name "damping-off" has been given. These troubles are caused by fungi which are present in the soil or carried on or in the seed. The character of the soil, temperature, amount of water used, drainage, aeration, and so forth, are factors influencing the extent of the injury. Typically, the seedlings decay at the soil line, thus causing them to topple. Perhaps equally common, if less frequently observed, is the decay which occurs before the young plants emerge from the soil and under certain conditions even before they germinate. The net result is a reduced stand of healthy seedlings.

Because of the importance of damping-off, plant pathologists have given considerable attention to its control and many methods involving the use of heat or chemicals have been proposed. Some of these methods are too specific in their effect to warrant general use while others have such disadvantages as high cost, low or uncertain effectiveness, complicated procedure, objectional character of work, and so forth, which have prevented their adoption. In the hope of sorting out a method that would be simple, effective, and available to most growers, we have tested most of the various methods in comparison with one another, under comparable experimental conditions, and believe that the one here presented has much to commend it.

As the test progressed, it became evident that the advantages of using a chemical outweighed the disadvantages and that formaldehyde in some form offered the most promise. The use of this chemical as a means of seed or soil disinfestation is by no means new. Diluted with water at the rate of 1 part to 50 it has long been used as a soil drench for disease control. Various concentrations of formaldehyde in water have also been suggested as dip treatments for certain seeds, corms, tubers and bulbs. More recently, formaldehyde, adsorbed on various inert carriers, has been marketed in dust form and has come into wide use as one of the better methods of damping-off control.

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THE IMPROVED METHODS

The method discussed in this paper is very similar to the one involving the use of formaldehyde dust, the only difference being that the disinfesting agent is in liquid rather than dust form. Essentially, the method consists of mixing known amounts of formaldehyde with various amounts of soil in which the seeds are to be sown. In actual practice and with a soil mixture consisting of one-half sand and one-half top soil, one would use two and one-half tablespoonfuls of commercial (approximately 40 per cent) formaldehyde for each bushel of soil. The dosage figured for the average sized flat with an inside measurement of 20 by 14 by 2-3/4 in. would be one level tablespoonful per flat. After the formaldehyde is measured out, it is diluted with about five or six times its volume of water, sprinkled over the correct amount of soil, and thoroughly mixed in. The treated soil is then placed in the flats or other containers and allowed to stand for 12 to 24 hours before the seeds are sown. Soon after sowing the seeds it is necessary to water the flats thoroughly. This serves to "release" the formaldehyde fumes and avoids injury to the seeds.

PRECAUTIONS

Certain precautions should be observed in order to obtain maximum control from the method outlined above. Before applying the formaldehyde solution, the moisture content and friability of the soil should be in proper condition for sowing the seeds. When mixing the solution with the soil, the job should be thorough. For the best results it is essential to wait from 12 to 24 hours before sowing the seeds. The need for watering the flats thoroughly soon after the seeds are sown cannot be emphasized too strongly. With soil mixtures in which the ratio of sand to soil is greater than one to one, it may be desirable to reduce slightly the actual amount of formaldehyde applied per bushel. Conversely, with soil mixtures high in organic matter due to the addition of leafmold, peat, muck, and similar materials, a slight increase in the amount of formaldehyde may be justified.

RESULTS OBTAINED

This method of damping-off control has been compared under comparable conditions with other methods now in common use such as formaldehyde dust in the soil, red copper oxide on the seeds, zinc oxide on the surface of the soil in combination with red copper oxide on the seeds, various organic mercury compounds used as dusts on the seeds or applied as liquids to the soil, and soil sterilized by heating with steam or electricity. The new liquid formaldehyde treatment has provided more effective control of damping-off than any of these treatments with the possible exception of the electrically heated soil. When compared with the latter method, the formaldehyde treatment has given results just as favorable and when seeds known to be carrying a disease organism were used the control obtained was better.

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ADVANTAGES OF THE NEW METHOD

The advantages of this liquid formaldehyde treatment are numerous and worthy of consideration. The actual cost of the formaldehyde will not be more than 1/2c. to 1c. per flat. The labor involved is no more than that required for many of the other common methods of control with the exception of those involving seed treatment alone. With this method, one is assured of using a disinfestant of known strength. There is no dissipation of the formaldehyde gas from the containers such as sometimes occurs with the various formaldehyde dusts. The method does not entail the use of expensive or labor-consuming equipment. Its effectiveness in comparison with other methods of damping-off control has already been pointed out. Finally, in common with the formaldehyde dust method, it enables one to obtain disinfestation of the soil, the seeds, and the flats or containers in a single operation.

Among the ornamentals which have responded well to this method of damping-off control are Calendula, China Aster, Clarkia, Gypsophila, Kochia, Larkspur, Lunaria, Marigold, Scabiosa, Stock, Strawflower, Sweet Pea, and Zinnia. Results obtained with Anchusa, Campanula, and Snapdragon were irregular and would indicate susceptibility to formaldehyde injury. A full 24-hour wait after treating the soil, however, largely eliminated this trouble. Several vegetables such as Beet, Carrot, Cucumber, Celery, Spinach, and Tomato have also been tested. With the exception of Celery, the results have been very promising. Additional information is being obtained with regard to many other ornamentals and vegetables. This together with all of the data obtained during the course of these investigations will be published subsequently in bulletin form.

Aside from damping-off control, the method here reported may prove of considerable benefit for the purpose of disinfesting soils in greenhouse benches or other areas where a cheap, quick, and effective procedure is desirable. Similarly, the method offers promise as a means of control for the various cutting rots which frequently cause serious losses in propagating benches. Further studies along these lines are now being conducted.

CHEMICAL SANITATION IN THE FLOUR MILL; A DISCUSSION OF MATERIALS AND METHODS

EDITOR'S NOTE:- The paper presented here was read by Mr. Ressler at the annual meeting of the Independent National Millers Association in Indianapolis, Indiana, May 17, last. It is printed here for the information of entomologists and others interested in pest control by fumigation.

By I. L. Ressler, Entomologist,
R. & H. Chemicals Department,
E. I. du Pont de Nemours & Co.

Chemical sanitation or the control of insects by chemical means may sound new to you. Yet the earliest artificial controls were brought about by employing chemicals. Early methods were crude and often resulted in failure because of a lack of knowledge both as regards the chemical employed; the nature, life and habits of the insects to be controlled and the effect and relationship to the products to be protected.

In the flour mill chemical control - fumigation - was first tried nearly 50 years before, shortly after the discovery of fumigation as a control for scale insects in orange groves. This method depended upon the combined action of potassium cyanide, sulfuric acid and water to release hydrocyanic acid gas. The method became known as the "pot method" because of the containers - crocks - used for the generation.

As the years progressed new methods of fumigation with hydrocyanic acid gas were developed. The cheaper sodium cyanide came into production to supplant potassium cyanide. Fumigation was reduced to an exact art with the development of knowledge of the science of fumigation in relation to the problems involved. Today the "pot method", or as it should be more properly designated, the generation method, continues in favor and growing popularity because of the greater economy. The various methods of controlling insects will be briefly discussed in the course of this talk which must of necessity deal in generalities.

During the past decade much progress has been made along lines of insect control in flour mills. We have seen the growing importance of beetle control (Confused flour beetle) until the necessity for eliminating these pests has overshadowed the older menace of the Mediterranean Flour Moth. There is no need to go into detailed descriptions of the various pests in the flour mill for you men are well acquainted with them.

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You are all familiar with the webbing of the Mediterranean Flour Moth and the manner in which socks in dust collectors, screw conveyors, sifters, elevator legs and panel boards of machinery are clogged and webbed up. This frequently causes costly shutdowns, unless constant remedial measures are employed. Fumigation is by far the most effective method to employ for the control of this pest. It will not destroy the webbing, however, which can only be removed by a thorough supplemental housecleaning. There are no known supplemental chemical controls which would destroy both webbing and moths.

As I mentioned at the start, beetles are of growing importance to the flour miller. The Confused flour beetle is the most serious, not because of actual damage done, but because of its universal prevalence throughout the mill and in the finished products. The presence of this insect in finished products frequently leads to consumer complaints which react against dealers, distributors and millers alike. Other beetles commonly found in flour mills are the Mealworms (yellow and dark), Cadelle beetles and Sawtoothed grain beetles. For all of them fumigation with hydrocyanic acid gas is recognized as the most adequate control.

Nothing will be said in this talk regarding insects found in stored grain. That subject involves a specialized discussion and treatment quite different than for pests in the flour mill. The insects usually encountered in stored grain are the Rice and Granary weevils, Angoumois grain moth and other insects that feed on whole grains rather than milled products.

CONTROL MEASURES

Fumigation with Hydrocyanic Acid Gas

There are several methods of fumigating with hydrocyanic acid gas. For purposes of brevity this gas will be referred to hereafter as HCN. Four sources of HCN as a fumigant will be discussed; A. - The Generation Method; B. - Liquid Hydrocyanic Acid; C. - Absorbed Hydrocyanic Acid; D. - The Powdered Cyanides.

A. The Generation Method

This is the most economical method of applying HCN. The chemicals required are sodium cyanide, minimum strength 96% and sulfuric acid, 66° Baumé. For flour mill work barrels are desirable as generators, although crocks and tubs are sometimes used. If barrels are used, fewer are required per unit of space fumigated, because larger charges of cyanide can be applied. A single barrel will permit the use of sufficient cyanide to fumigate spaces ranging up to 35,000 cubic feet.

Many millers are familiar with this method of fumigating and have been employing it for years. The largest flour mill fumigation in the United States uses this method with excellent success. The procedure is simple and can readily be mastered by intelligent employees.

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The sodium cyanide generally sold for this type of fumigation is found on the market as one-ounce, egg-shaped pieces, providing a convenient method of computing dosages without the use of scales.

The acid is diluted to the desired strength by pouring it carefully into water. Then the computed charges of cyanide in paper sacks are dropped into the acid-water mixture by workers properly protected with gas-masks and gloves. Time will not permit a detailed discussion of this method. I will be glad to go into detail on the generation method with any of you who may be interested in becoming better acquainted with it.

B. Liquid Hydrocyanic Acid.

Next in importance, but more costly, is fumigation with liquid hydrocyanic acid, or, as it is more generally referred to -- liquid HCN. This material releases hydrocyanic acid gas by volatilization and is applied through a piping system. The piping may be a permanent installation or flexible copper tubing may be employed. Where copper tubing is used the installation is temporary and can be removed for transportation to other jobs.

Liquid HCN is supplied in pressure cylinders and is forced out into the piping system by air pressure. The pipes are equipped with nozzles at suitable intervals and the liquid enters the mill as a fine mist where it volatilizes. This type of fumigation is usually carried on by experts engaged in commercial fumigation. Liquid HCN in the hands of the uninitiated is considered extremely hazardous; in all cases the services of fumigation experts should be employed for its application.

C. Absorbed Hydrocyanic Acid.

Liquid hydrocyanic acid absorbed in a porous material of fibrous nature is used to some extent in flour mill fumigation. This product comes on the market in hermetically sealed tin cans. The material is scattered about in the space to be fumigated and releases the gas by volatilization. A frequent use is made of this material for small localized areas which may be heavy centers of infestation. Because of working in an immediate concentration of gas, it is doubly essential that workers be adequately protected during all steps in the actual fumigation operation.

D. The Powdered Cyanides.

There are two forms of powdered cyanides used for mill fumigation. One comes on the market in the form of fine granules, grey in color, and which releases its gas by the action of air moisture. It is applied by spreading on the floor in a thin layer. Broadcasting with shovels or small scoops is the method usually employed in spreading. At the end of the fumigation period the residue is swept up and disposed of. This method of fumigation requires the same precautions and protective measures as for any type of hydrocyanic acid gas work, both during the application and clean-up.

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The second powder is a brown, finely divided material which also depends upon air moisture for the release of its gas. It may be spread out in very thin layers on paper or applied by means of a machine developed during the past several years. The latter method is confined to localized fumigations since costs for general fumigations must be kept within economic bounds.

Supplemental Control Measures

Materials applied in the form of sprays are quite generally used in flour mills. Some of these which may contain trichlorethylene, carbon tetrachloride or ethylene dichloride serve to a certain extent as fumigants. Most of them, however, contain a petroleum oil as the base to which toxic ingredients may be added.

Sprays must at all times be considered as a supplemental treatment to fumigation. They can in no instance take the place of fumigation since they kill by contact only. In many instances insects may be merely stupefied and will revive after a period and regain their original position as a pest and source of fresh infestation.

FUMIGATION VAULTS

Every flour mill should have a fumigation vault or specially built gas-tight room which can be used for the treatment of packaged and sacked goods. All such goods should be fumigated before shipment to the trade. The assurance that insect-free goods are leaving your plant will go a long way towards eliminating complaints from the trade.

Hydrocyanic acid gas, particularly the generation method, is ideally adapted to use in special fumigation rooms. It is inexpensive, easy and simple to apply, and can readily be evacuated from the room to facilitate early removal of goods. Specifications for the design and operation of fumigation vaults are obtainable from companies specializing in the sale of fumigants.

Of particular importance to prevent the introduction of insect pests from the outside is the treatment of returned used sacks. These sacks, which usually come back in tight bundles, frequently contain live insects, particularly Confused flour beetles, and eggs, as well as the eggs of other insects which might become pests in the mill. Bundles of sacks should be loosened and placed in loose fashion in the fumigation vault and fumigated, preferably given an overnight fumigation with an extra heavy dose of hydrocyanic acid gas at the rate of about one pound of the gas per 1000 cu. ft. of space, or equivalent to the use of approximately 2-1/4 lbs. of sodium cyanide where the generation method is used.

GOOD HOUSEKEEPING AS AN AID IN INSECT CONTROL

Good housekeeping is a most valuable aid in the control of insects. Accumulations of flour, dust, used sacks and old unmoved stock serve

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as breeding centers for flour mill pests. Cleanliness in the mill is one of the worst enemies of insects. The most important practice recommended before a fumigation is a thorough clean-up. This involves not only the features mentioned above, but requires a clean-up in machinery, screw conveyors and dust collectors. Without proper clean-up, fumigations sometimes fail. Such failures are too often blamed on the fumigant which was not given sufficient opportunity to penetrate into all parts of the mill.

A FUMIGATION PROGRAM

I urge all millers to establish a well organized and systematic fumigation program. The older practice of one or two fumigations in a season does not always give the desired degree of control due to the fact that there are many sources of infestation by the introduction of pests that may be transported into the mill. In the long run, the fear of insect troubles can be eliminated and a sense of security brought about if an adequate program is carried through. I have enumerated below the various steps in an ideal fumigation program. Due to many conditions existing during the past years, both competitive and economic, little headway could be made in advancing the practices suggested. It is hoped that eventually the objectives set forth can be met by millers, and I am sure that all who do follow the practice will be well repaid.

1. Give the mill (after the proper clean-up) a thorough general fumigation, preferably between May 1st and June 15th, depending upon seasonal conditions and locality.

2. Follow with a weekly fumigation, one floor of the mill per week until the entire mill has been fumigated again.

3. Then give periodic fumigations at intervals of two or three weeks, fumigating one or two floors at a time, taking each unit progressively until entire mill has been fumigated.

4. Continue this practice until October 1st to November 1st. Seasonal conditions and locality again govern the end of the fumigation period.

5. Supplement fumigations with spraying to control flying moths or other insects that may fly or migrate by walking from one part of the mill to the other.

6. Adopt the practice of fumigating all packaged or sacked goods in a gas-tight vault or room before making shipments to the trade.

LEARNING THE ART OF FUMIGATION

Fumigation is an art regulated by well defined practices. The generation method can be readily mastered by any competent employee. The essentials are set forth as follows:

1. Select a crew of from 2 to 6 competent employees, with one man designated as the foreman.

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2. Supply them with complete directions for the work.

3. Have each man thoroughly master the procedure and particularly the safety practices.

4. See that every one in the crew is equipped with the necessary protective devices such as gas masks, rubber gloves and goggles.

5. Delegate specific responsibilities to the several men of the crew.

6. Carry out "dummy" fumigations or rehearsals until each man has thoroughly familiarized himself with his duties.

CONCLUSION

I hope that this talk will prove an inspiration to you and open the way for an expanded insect control program in the flour mill. Most of you can recall the time when insects were a comparatively minor factor in the control of your business. I'm sure all of you are aware of the numerous complaints that have originated with the consumer and the retail trade, with their subsequent losses. Most of you who sell for export know what it means to have an entire shipment rejected after reaching the destination, simply because of the presence of a few insects.

Insure yourself against such losses as much as it is possible to do so; but keep in mind that where Mother Nature, climate, and insects are concerned you cannot provide for 100 per cent insurance against loss. There are many factors other than those found in the flour mill which may be responsible for infested products reaching the consumer. Insect ridden freight cars or ships, infested wholesale warehouses, and grocery stores and natural migrations of insects are all major factors. These are beyond the control of the miller. A regulated practice of insect control all along the line will prove to be a measure of freedom from insect attack and serve to a certain extent to curb the seriousness of insect migrations. In any event it is within your power to send insect-free goods out of your mill if you follow sound control practices.

FERTILIZER INVESTIGATIONS CONDUCTED IN ALABAMA POINT WAY TO INCREASE VALUE OF THE COTTON CROP

EDITOR'S NOTE:- Facts of value to cotton planters and agronomists are presented in a Special Circular, April, 1935, issued by the Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn, Alabama, M. J. Funchess, Director. Below are excerpts from this circular, titled, "Agricultural Research for the Alabama Farmer."

Potential Value of Fertilizer Formulae Experiments for Cotton at Substations and Experiment Fields

Alabama farmers spend annually some ten to eighteen million dollars for fertilizers. It is known that many of these fertilizers are not well adapted for the crops to which they are applied. Among the new experiments started on the substations and experiment fields provided by the 1927 Legislature are those dealing with the subject of fertilizers for cotton. The following example shows a potential value of $15,269,912 that may accrue annually to Alabama as the result of the facts gained by these experiments with fertilizers.

The figures given here are based on the following items:

(1) Tons of each grade of fertilizer used during 1933.
(2) The efficiency of each grade as shown by average yields at eight different places.
(3) That seed cotton is worth four cents per pound.
(4) Fertilizer cost at code prices - subtracted.
(5) No credit is given for cotton seed produced.

Formulae	Tons sold	Acres could be fertilized at 600 pounds	Difference in favor of 6-8-4 over various grades per acre	Difference in value of cotton from use of a good fertilizer and those indicated
2-11-3	25,084	83,613	$9.20	$ 769,239
2.5-10-4	7,282	24,273	8.77	212,874
3-8-5	99,528	331,760	7.48	2,481,565
3-10-3	36,143	120,476	6.66	802,370
4-8-4	60,148	200,493	4.38	878,159
4-10-4	20,499	66,663	4.24	282,651
4-12-4	1,888	6,293	4.24	26,682
Total	250,572*	833,571*	-----	$5,453,540

*This represents nearly all of the fertilizer used and only about one fourth the cotton acreage.

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If all cotton grown in Alabama were well fertilized, the value of the cotton crop produced would be $21,814,160 greater than if poor fertilizers were used. However, it is estimated that thirty per cent of the crop receives a good fertilizer due to a sufficient side dressing of nitrogen. This leaves seventy per cent of the crop not properly fertilized. Proper fertilizers applied to this part of the crop would net annually $15,269,912. This amount of money would be sufficient to pay the appropriations of all substations and experiment fields for more than 150 years.

The Potential Value of Using Limestone in Mixed Fertilizers for Cotton to Make a Neutral Mixture

For many years farmers have been advised to lime their land. However, the annual increases from applications of lime are small and farmers have not been convinced that liming is a good practice. At the same time, farmers have been applying acid-forming fertilizers to their land for many years. Recently, the Experiment Station conducted an experiment to determine the value of small amounts of lime mixed with the fertilizer. The results obtained on more than 250 experiments on farmers' land show that the annual net value of replacing a portion of the filler with a little lime in the fertilizer that is applied to cotton will give an increase in yield that is sufficient to pay the total cost of the Experiment Station program for nearly thirty years. Beginning this year, practically all fertilizers sold in Alabama will carry lime. The following statements illustrate the potential value derived from this experiment:

	Yield per acre Lbs. seed cotton
Complete fertilizer - with limestone	1,043
Complete fertilizer - without limestone	993
Increase due to limestone	50

This increased seed cotton is valued at four cents per pound or $2.00 per acre. It is estimated that there are 3,000,000 acres of acid soils in Alabama where neutral or basis fertilizer should be used.

3,000,000 acres times $2.00 per acre equals	$6,000,000
This limestone would cost $1.50 per ton or	450,000
Leaving a potential net value of	$5,550,000

Potential Saving to the Farmers by Substituting Inorganic Nitrogen for the Organic Nitrogen in Mixed Fertilizers

It is estimated that approximately fifteen per cent of the nitrogen content of the mixed fertilizers sold in Alabama is derived from organic ammoniates. It is known that the cost of organic ammoniates is about 3.3 times as much as that of inorganic sources per unit of nitrogen.

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Experiments conducted on the substations and experiment fields indicate that inorganic sources of nitrogen are as efficient as organic sources provided that the acidity developed is corrected.

Farmers may be saved annually from $200,000 to $400,000 by substituting cheaper forms of nitrogen for the organic form now used. This one small saving is sufficient to pay the entire agricultural research bill for a year. These figures are based on the following data:-

Based on Fertilizer sold in 1933 (Low sales - 269,722 tons)
15 per cent of nitrogen in 269,722 tons fertilizer equals
130,240 units.

Source of nitrogen	Per unit	Total
Cost of nitrogen in organic ammoniates	$3.30	$429,792
Cost of inorganic nitrogen*	1.00	130,240
Annual saving to farmers	2.30	299,552

*Sufficient to replace the organic ammoniates used.

METHODS OF BLASTING LATERAL-ROOTED STUMPS IN TERRACING WORK TO PREVENT SOIL EROSION

EDITOR'S NOTE:- In the June issue of this publication Mr. Livingston discussed the use of explosives for blasting tap-rooted stumps. This article, dealing with the removal of lateral-rooted stumps, is for the information of those concerned with the work of terracing fields in Northern and Western States. Gully bank blasting will be described in an early issue.

By L. F. Livingston, Manager,
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Renewed interest in the removal of stumps and boulders from farm lands has been created by the announcement that approximately 100,000 members of the Civilian Conservation Corps are being assigned to the work of assisting farmers in terracing projects to prevent soil erosion. The plan calls for land owners to take care of the terracing of fields and for the CCC men to construct outlets.

In many instances, it is being found necessary to clear terrace lines of stumps to permit the use of the mechanical equipment required for terracing. Explosives are being used to blast out stumps which cannot be removed by other means.

Mostly, the stumps found in Northern and Western States are lateral-rooted. The small sizes may in many cases be removed by the use of the so-called Paul Bunyon hammer or other mechanical means. However, it is a recognized fact that any stump, other than a really small one, can be taken out quicker by blasting than by any other means. Large stumps usually require the use of explosives.

Proper Tools are Needed

For stump blasting, as for any other work, proper tools are required. These tools should include earth augers, driving irons -- one with a plain point and one with a bulge point -- , a sledge hammer, a monkey wrench and a "spoon". In addition, there is need for a wooden tamping stick. All these tools, except the sledge and the monkey wrench, are made especially for blasting work. They may be obtained through dealers in explosives or can be made by a blacksmith.

Selecting the Explosive

The best results and the greatest savings in costs of blasting depend primarily on the selection of an explosive developed expressly for stump blasting. This explosive, when properly loaded, should heave pieces of a stump out of the ground without leaving an unduly

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large hole to be filled. Further, the action of the explosive should be such as to split a stump into pieces that can be easily handled, tear the roots loose from the earth and turn the pieces back around the hole. Also, it should be "high count"; that is, average the maximum number of cartridges to a case. The latter is, of course, an important factor from the standpoint of economy.

Where and How to Load Stumps

For blasting stumps which have spreading or lateral-roots -- among which are white pine, oak and maple -- the explosive may be placed in a single hole under the body of the stump or the charge may be divided among two, three or four holes under the heavier roots. If a single charge will blow a stump out, it is better to do the blasting in that way because less work is required than when several holes are made and loaded.

In connection with the use of a single charge, facts to consider are:

1 - The explosion of a charge of dynamite in the ground blows out an inverted right-angled cone of earth. It is, therefore, necessary, when blasting an evenly rooted stump, to locate the charge of explosive under the center of the stump and at such depth that when the cone is blown out the force of the explosion will be exerted principally upon the body of the stump and the thicker part of the roots.

2 - If the charge is placed too deep, considerable of the force of the explosion will be wasted in blowing out earth. Also the crater will be unnecessarily large.

3 - If the charge under an evenly rooted stump is located off center, it will blow out the roots on one side of the stump and leave those on the other side fast or blow out but part of the stump and its roots.

4 - If a stump has much larger roots on one side than on the other, place the charge under that side.

Depending on the type of soil, the hole to receive the explosive is made with a driving bar, an earth auger or a spoon. In dry sand or crumbly earth that caves when a bar or an auger is pulled out, a blasting spoon is the only tool that can be used to make a hole.

Just before loading each cartridge -- except the last one, which is used for a primer -- slit the paper of the cartridge lengthwise in three or four places with a sharp knife so that the explosive can be pressed down into less space. But do not slit the cartridges if there is water in the hole or if the soil dug out leaves a film of moisture on the hand when the soil is squeezed. The reason for this is that if an explosive takes up moisture, it may fail to explode or it may simply burn in the hole.

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The primer cartridge, which is inserted last, should not be slit. It is primed with a blasting cap and safety fuse of sufficient length.

The slit cartridges are pushed down to the bottom of the hole with the wooden tamping stick and packed solidly. A metal "stick" should never be used, owing to the danger of a spark resulting from contact with a piece of rock in the earth.

After all the other cartridges have been loaded, the primer cartridge is pushed down the hole. Care should be taken to see that the primer rests solidly on the explosive in the bottom of the hole.

It is important that the fuse or cap wires be held with one hand while using the tamping stick to push the primer cartridge down the hole.

The Importance of Correct Tamping

No explosive generates its full power unless it is adequately confined. It, therefore, is necessary to properly tamp a loaded hole. Failure to tamp a hole tight results in the waste of explosive and a blast may merely split a stump instead of throwing it out.

When ready to tamp a hole, pour in a handful of earth or sand and tamp it lightly. Keep adding tamping material and tamp each lot very firmly until the hole is completely filled. The hole is now ready to shoot.

The same procedure is followed in the case of a large stump with long, heavy roots. However, for such blasting, it is best to use two or more charges. The holes should be located at points where the roots offer the greatest resistance. In other words, the charges should be placed under the larger roots.

When more than one charge is necessary, the primer cartridges must be primed with electric blasting caps. The caps are wired in series and fired with an electric blasting machine.

Knowing and Observing Safety Rules

No one should attempt to do stump blasting or make any use of explosives until fully informed as to the proper procedure and is familiar with standard safety practices. It is, of course, highly important that safety rules be observed strictly.

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